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(54) **INTAKE SYSTEM FOR A VEHICLE, AND ENGINE INCLUDING SAME**

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F02M 35/116	(2006.01)
F02M 35/16	(2006.01)
F02M 61/14	(2006.01)
F02D 9/10	(2006.01)

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USPC ..... 123/184.21, 184.31, 184.34, 198 E, 336, 123/337, 470

See application file for complete search history.

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(57) **ABSTRACT**

An intake system for a vehicle includes an air cleaner assembly in a compact size. Intake passages introduce intake air to front and rear cylinder blocks of a multicylinder engine, and an air cleaner assembly is connected to upstream ends of the intake passages. A space inside an air cleaner case of the air cleaner assembly is partitioned into upper and lower sides by a partition wall, forming a clean chamber above the partition wall and a dirty chamber below. The intake passages are arranged to pass through the dirty chamber in an up-down direction, and inlets of the intake passages are arranged in the clean chamber. A through hole is formed in the partition wall between the intake passages for the front and rear cylinder blocks. An air cleaner element, configured to clean incoming intake air, is arranged to occlude the through hole.

20 Claims, 7 Drawing Sheets

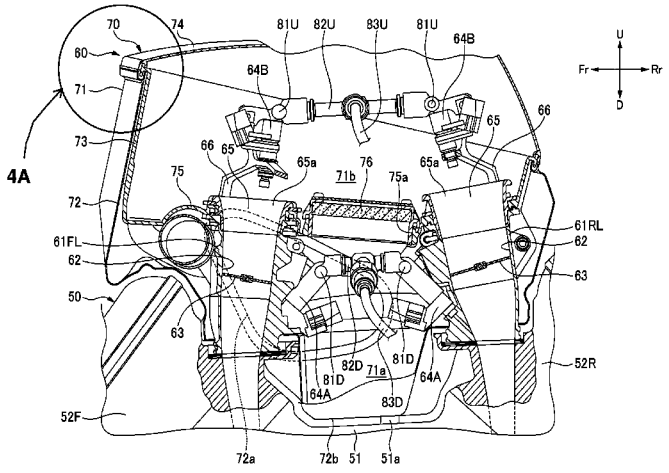

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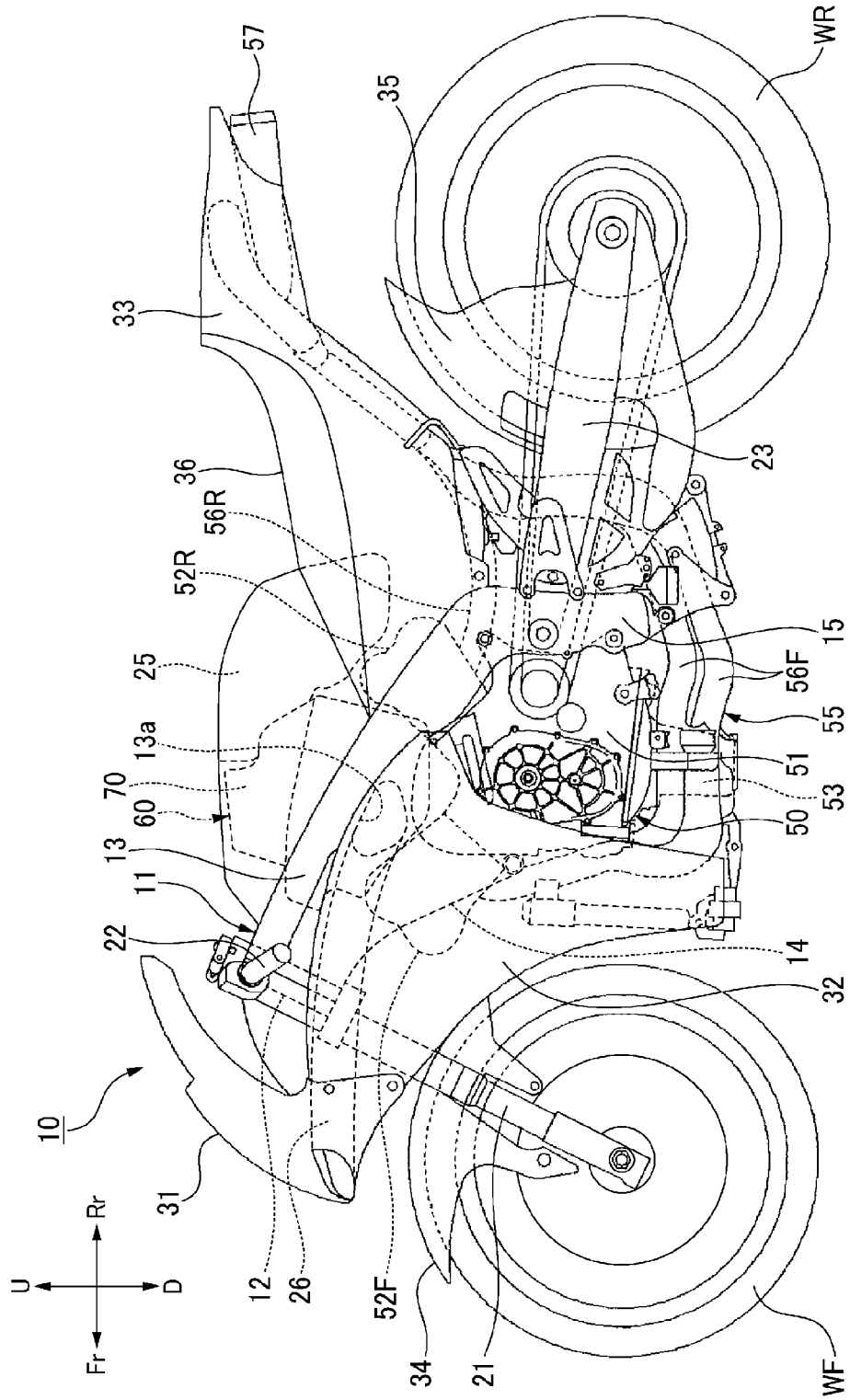
Fig. 1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36
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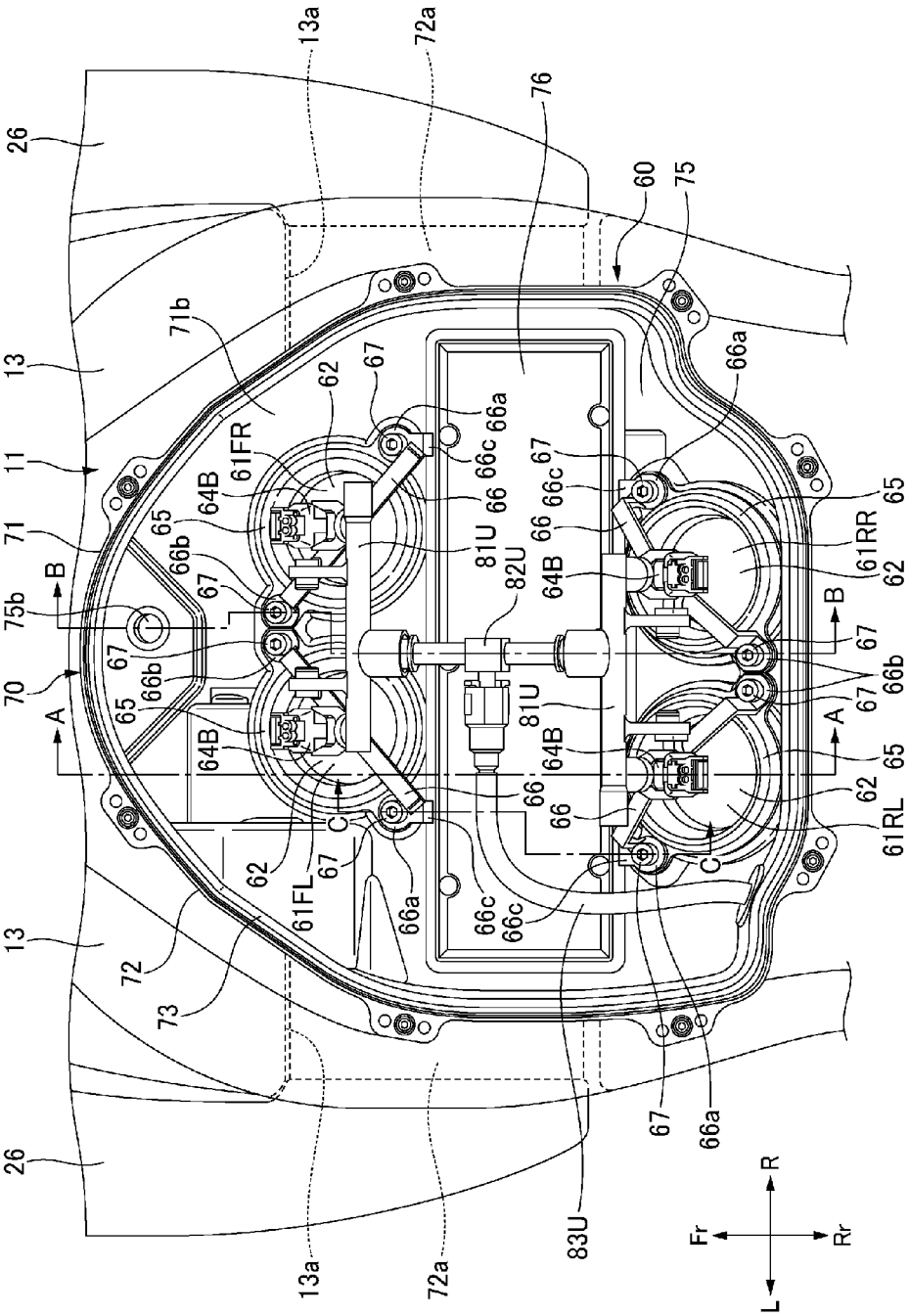
Fig. 2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71
66b
B
75b
70
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62
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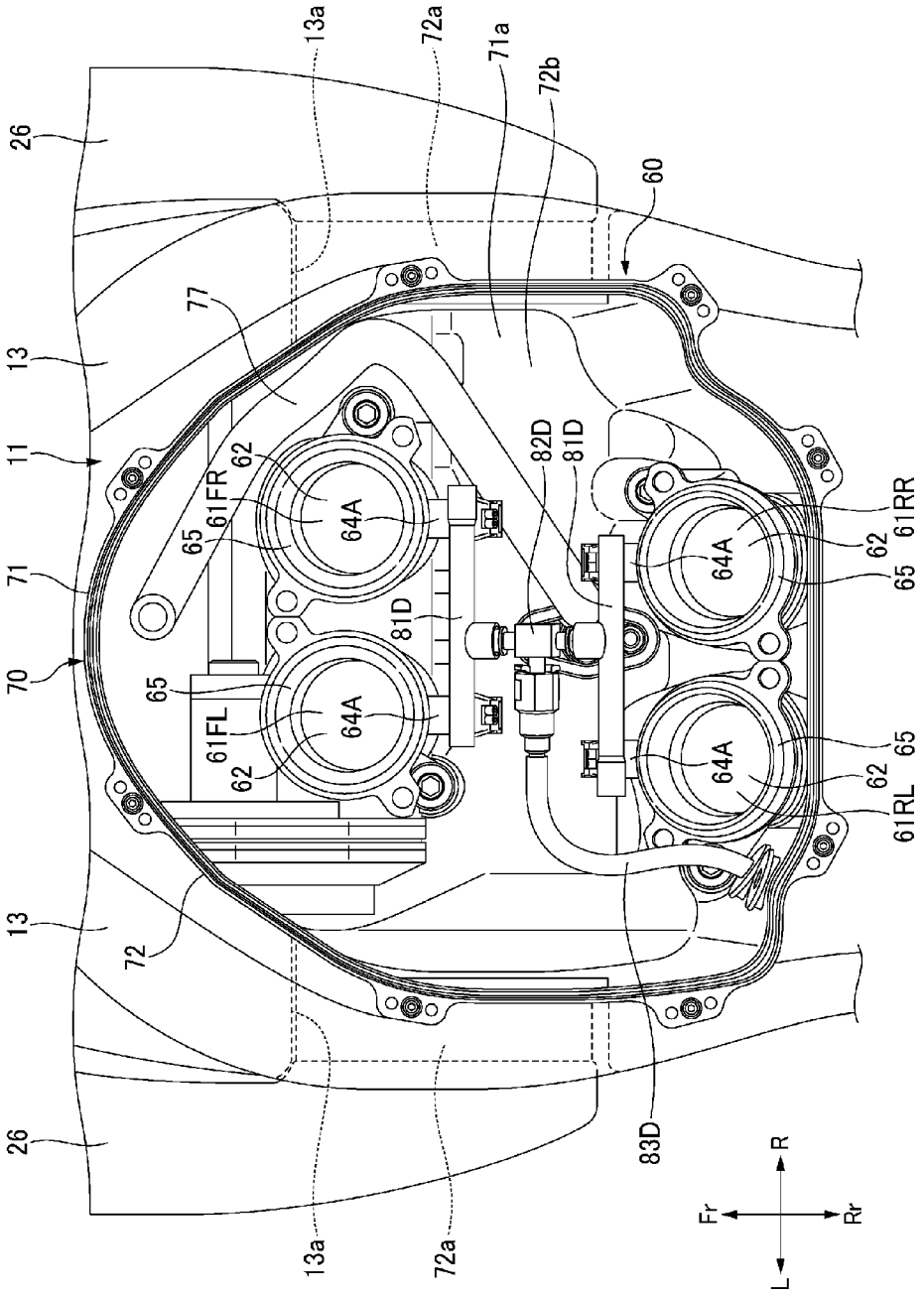
R
L

Fig. 3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81D
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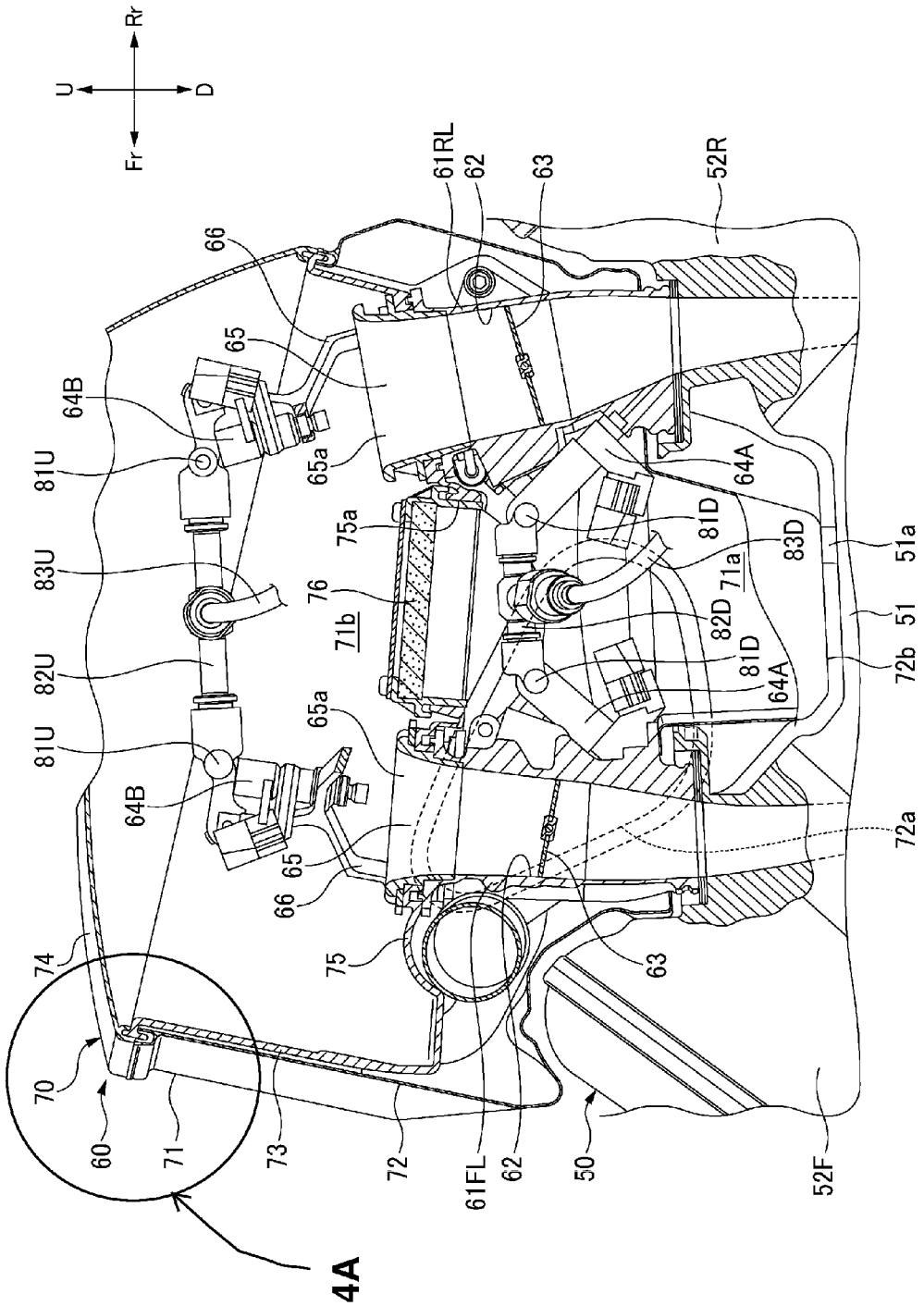
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71b
71a
82D
51
82U
81D
72b
64A
65a
81U
64B
72a
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61FL
62
50
52F
4A

Fig. 4

Fig. 4A

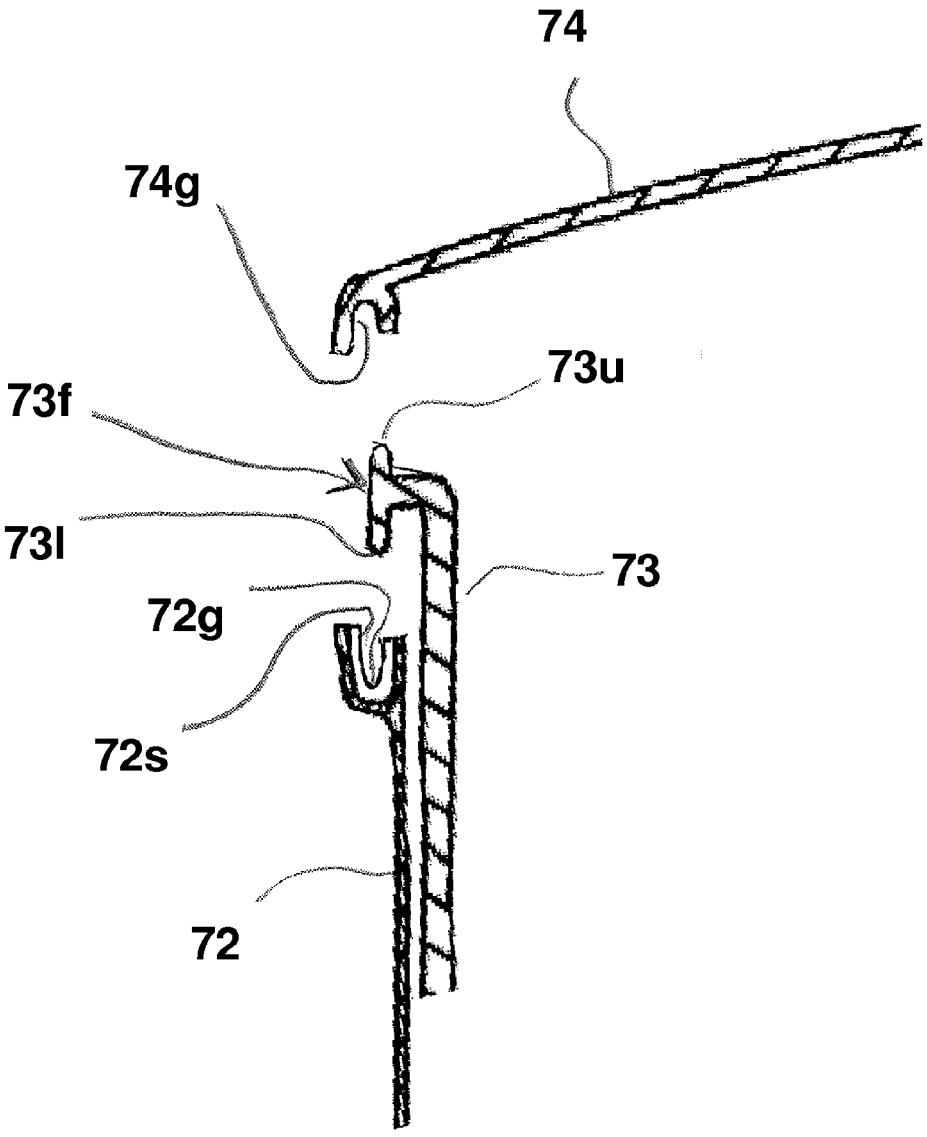
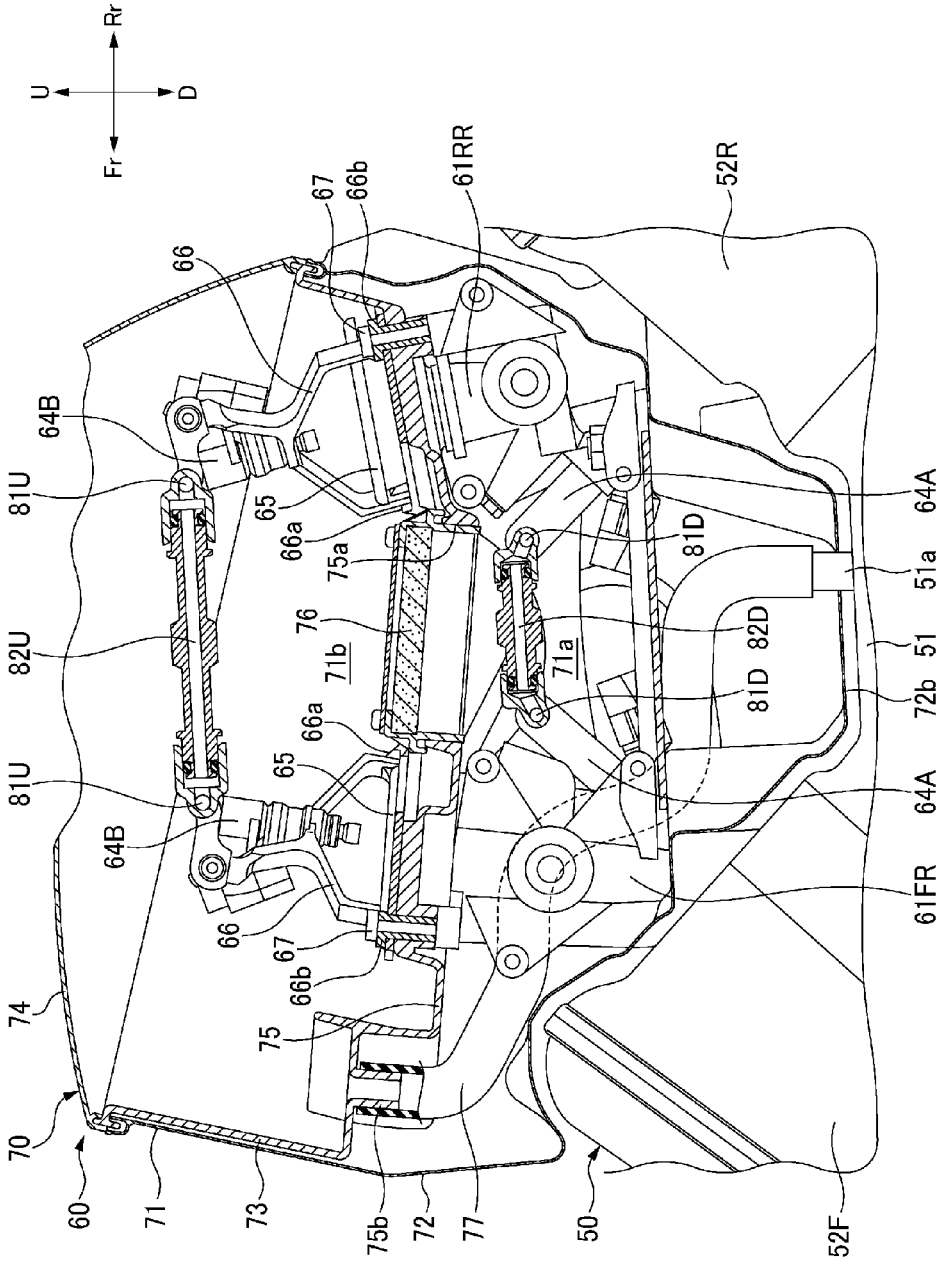


Fig. 5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71b
71a
82U
82D
51
81D
72b
66a
65
81U
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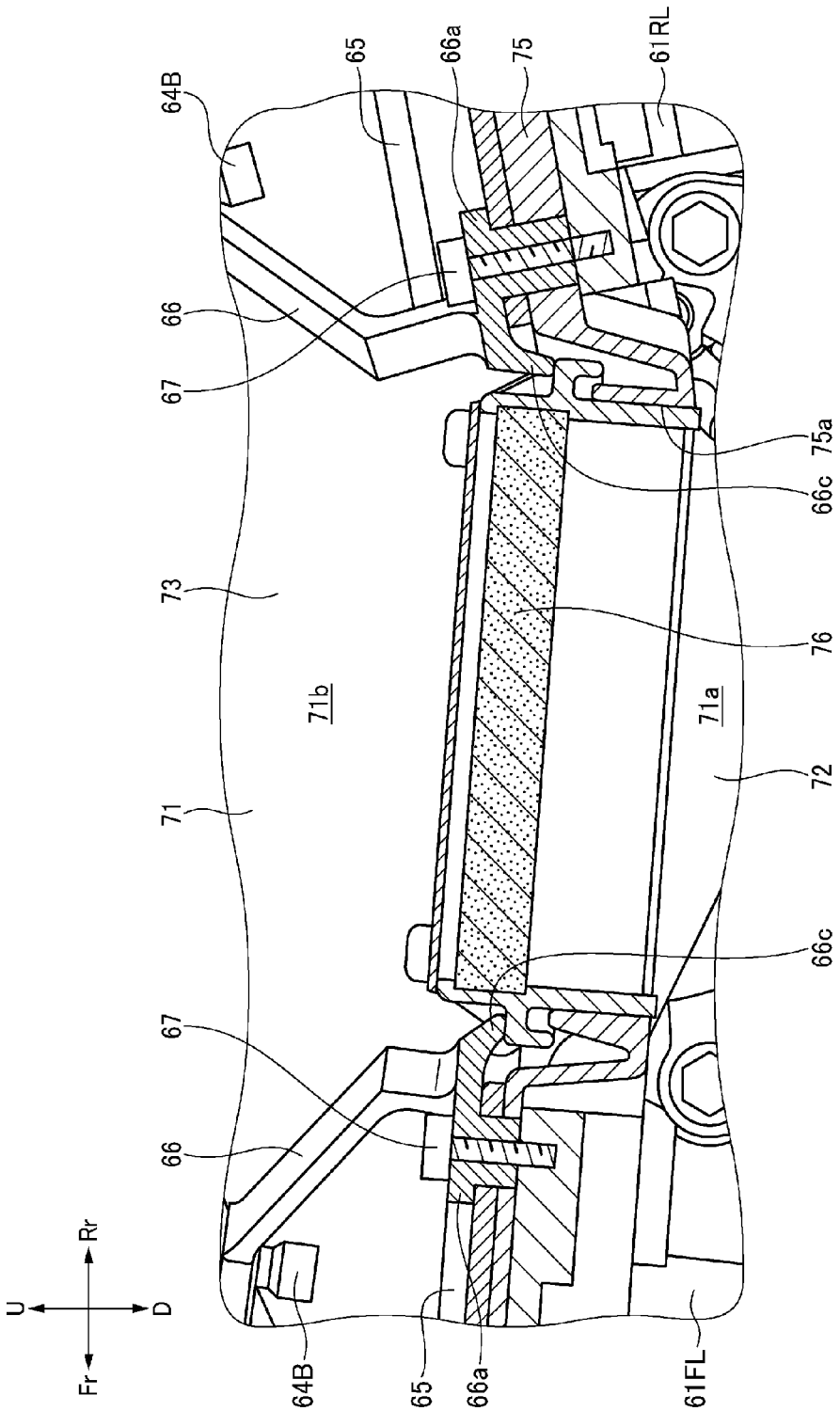
Fig. 6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64B
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66a
61FL

INTAKE SYSTEM FOR A VEHICLE, AND ENGINE INCLUDING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention claims priority under 35 USC 119 based on Japanese patent application No. 2012-285985, filed on Dec. 27, 2012. The entire subject matter of this priority document, including specification claims and drawings thereof, is incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an intake system for a vehicle, and particularly relates to an intake system for a motorcycle.

2. Description of the Background Art

As a conventional intake system, there is a known system where, in an engine including multiple cylinder blocks arranged on the front and rear sides, an air cleaner case is partitioned into an upper side for a clean chamber and a lower side for a dirty chamber; intake passages for the respective cylinder blocks are arranged to pass through the dirty chamber in an up-down direction; inlets of the intake passages for the respective cylinder blocks are arranged in the clean chamber; and an air cleaner element configured to clean intake air is arranged in front of the intake passages for the front cylinder blocks (for example, see Patent Document 1).

[Patent Document 1] Japanese Patent No. 4421941

Problem to be Solved by the Invention

The vehicular intake system according to Patent Document 1 described above, however, has a possibility that an air cleaner assembly may increase in front-rear dimension and top-bottom dimension because the air cleaner element is arranged to stand in front of the intake passages for the front cylinder blocks.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the foregoing circumstances, and has an objective of providing a vehicular intake system which makes it possible to maintain a compact size of the air cleaner assembly, by arranging components thereof in an efficient manner.

For the purpose of solving the above-mentioned problem, a first aspect of the present invention provides a vehicular intake system comprising: a multicylinder engine including at least one front cylinder block and at least one rear cylinder block; intake passages configured to introduce intake air to the front and rear cylinder blocks, respectively; and an air cleaner assembly connected to upstream ends of the intake passages for the front and rear cylinder blocks, wherein a space inside an air cleaner case of the air cleaner assembly is partitioned into upper and lower sides by a partition wall, thereby forming a clean chamber on the upper side and a dirty chamber on the lower side, the intake passages are arranged to pass through the dirty chamber in an up-down direction, and inlets of the intake passages are arranged inside the clean chamber, a through hole is formed between the intake passages for the front and rear cylinder blocks in the partition wall, and an air cleaner element configured to clean the intake air is arranged to occlude the through hole.

In a second aspect of the present invention, in addition to the configuration of the first aspect, the engine is a V engine, and the air cleaner element is formed into a plate-like body having a longitudinal dimension that exceeds a width across outermost edges of the intake passages for the front and rear cylinder blocks.

In a third aspect of the present invention, in addition to the configuration of the first or second aspect, front and rear fuel injection valves configured to inject a fuel to the respective intake passages for the front and rear cylinder blocks are arranged in the clean chamber, and the air cleaner element is arranged below the fuel injection valves.

In a fourth aspect of the present invention, in addition to the configuration of the third aspect, a fuel supply pipe connecting the front and rear fuel injection valves to each other is arranged above the air cleaner element, and a fuel hose is detachably connected to the fuel supply pipe above the air cleaner element.

In a fifth aspect of the present invention, in addition to the configuration of the third or fourth aspect, the fuel injection valves are fuel injection valves on an upstream side, the intake system comprises throttle bodies forming the respective intake passages for the front and rear cylinder blocks and including fuel injection valves on a downstream side, respectively, and the air cleaner element is arranged between the fuel injection valves on the upstream side and the fuel injection valves on the downstream side.

In a sixth aspect of the present invention, in addition to the configuration of the fifth aspect, the air cleaner element is arranged between a fuel hose connected to the fuel injection valves on the upstream side, and a fuel hose connected to the fuel injection valves on the downstream side.

In a seventh aspect of the present invention, in addition to the configuration of any one of the third to sixth aspects, the intake system further comprises supporting members configured to support the front and rear fuel injection valves above the intake passages, and each of the supporting members is provided with an integrated alignment portion configured to align a position of the air cleaner element.

In an eighth aspect of the present invention, in addition to the configuration of the seventh aspect, the engine is an inline V engine comprising two front cylinder blocks and two rear cylinder blocks, and the alignment portions of the supporting members are arranged respectively near distant-and-opposite outer edges of the neighboring intake passages for the two front cylinder blocks, and near distant-and-opposite outer edges of the neighboring intake passages for the two rear cylinder blocks.

Effects of the Invention

According to the first aspect of the present invention, the space inside the air cleaner case of the air cleaner assembly is partitioned into the upper side and the lower side by the partition wall, thereby forming the clean chamber on the upper side and the dirty chamber on the lower side, the intake passages are arranged to pass through the dirty chamber in the up-down direction, the inlets of the intake passages are arranged in the clean chamber, the through hole is formed between the intake passages for the front and rear cylinder blocks in the partition wall, and the air cleaner element configured to clean the intake air is arranged to occlude the through hole. Thus, the air cleaner element can be arranged by using the space between the intake passages for the front and rear cylinder blocks. This makes it possible to prevent the air cleaner assembly from getting larger.

According to the second aspect of the present invention, the engine is the V engine; and the air cleaner element is formed into the plate-like body having the longitudinal dimension that exceeds the width across the outermost edges of the intake passages for the front and rear cylinder blocks. For this reason, even if the air cleaner element is arranged in the space between the narrowly-spaced intake passages, a cleaning area of the air cleaner element can be secured.

According to the third aspect of the present invention, the front and rear fuel injection valves configured to inject a fuel to the respective intake passages for the front and rear cylinder blocks are arranged in the clean chamber, and the air cleaner element is arranged below the fuel injection valves. Thus, even when the front and rear fuel injection valves are arranged in the clean chamber, the air cleaner element can be arranged in an empty space where the air cleaner element does not interfere with the front and rear fuel injection valves.

According to the fourth aspect of the present invention, the fuel supply pipe connecting the front and rear fuel injection valves to each other is arranged above the air cleaner element, and the fuel hose is detachably connected to the fuel supply pipe above the air cleaner element. Thus, in cleaning or replacement of the air cleaner element, the fuel hose can be easily detached, and thereby the air cleaner element can be easily detached.

According to the fifth aspect of the present invention, the air cleaner element is arranged between the fuel injection valves on the upstream side and the fuel injection valves on the downstream side. Thus, the air cleaner element can be arranged in an empty space where the air cleaner element does not interfere with the fuel injection valves on the upstream side and the downstream side.

According to the sixth aspect of the present invention, the air cleaner element is arranged between the fuel hose connected to the fuel injection valves on the upstream side, and the fuel hose connected to the fuel injection valves on the downstream side. Thus, in cleaning and replacement of the air cleaner element, the fuel hose on the upstream side can be easily detached and attached. In addition, since the fuel hose on the downstream side can be viewed through the through hole of the partition wall, the fuel hose on the downstream side can be easily detached and attached.

According to the seventh aspect of the present invention, the intake system further comprises the supporting members configured to support the front and rear fuel injection valves above the intake passages, respectively. Each of the supporting members is provided with the integrated alignment portion configured to align a position of the air cleaner element. Thus, there is no need to provide any additional members to align a position of the air cleaner element. This enables reduction in the number of parts, and consequently leads to reduction in manufacturing costs.

According to the eighth aspect of the present invention, the engine is the inline V engine comprising the two front cylinder blocks and the two rear cylinder blocks, and the alignment portions of the supporting members are arranged respectively near the distant-and-opposite outer edges of the neighboring intake passages for the two front cylinder blocks, and near the distant-and-opposite outer edges of the neighboring intake passages for the two rear cylinder blocks. Thus, the positions of the alignment portions fixing the air cleaner element are spaced, so that the air cleaner element can be firmly fixed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a left-side view illustrating a motorcycle equipped with an embodiment of a vehicular intake system according to the present invention.

FIG. **2** is an upper side view of the intake system illustrated in FIG. **1**, with a lid portion omitted from the drawing for illustrative purposes.

FIG. **3** is an upper view of the intake system illustrated in FIG. **2**, with an upper case additionally removed from the drawing for illustrative purposes.

FIG. **4** is a cross sectional view of the intake system of FIG. **2**, taken along a line A-A.

FIG. **4**A is an exploded detail view of a portion of an air cleaner housing which is a component of the intake system of FIG. **4** shown within the circular area designated as **4**A.

FIG. **5** is a cross sectional view of the intake system of FIG. **2**, taken along a line B-B.

FIG. **6** is a cross sectional detail view of a portion of the intake system of FIG. **5**.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Hereinafter, an embodiment of a vehicular intake system according to the present invention is described in detail with reference to the accompanying drawings. It should be noted that the drawings should be viewed in the same orientation as the reference numerals. In the following description, front-rear, left-right, up-down are defined according to directions viewed from a vantage point of a driver seated on the motorcycle **10** and facing forward. The drawings include directional indicia Fr, Rr, L, R, U, and D for indicating the front side, the rear side, the left side, the right side, the upper side and the lower side of a vehicle, respectively.

In a motorcycle **10** of the present embodiment, as illustrated in FIG. **1**, a vehicle body frame **11** includes a head pipe **12** provided at the front end thereof, a pair of left and right main frames **13** extending rearward and downward from the head pipe **12**, a pair of left and right engine hangers **14** extending downward from lower surfaces of front portions of the pair of left and right main frames **13**, a pair of left and right pivot frames **15** connected to rear end portions of the pair of left and right main frames **13** and extending downward. An engine **50** is attached to the engine hangers **14** and the pivot frames **15**.

Moreover, the motorcycle **10** includes a front fork **21** supported in a fully steerable manner by the head pipe **12**, a front wheel WF rotatably supported by an lower end portion of the front fork **21**, a steering handlebar **22** attached to an upper end portion of the front fork **21**, a rear swing arm **23** pivotally supported by the pivot frames **15**, a rear wheel WR rotatably supported by an rear end portion of the swing arm **23**, an intake system **60** arranged between the left and right main frame **13** above the engine **50**, and a fuel tank **25** arranged behind the intake system **60**. Also as shown in FIG. **1**, reference numeral **31** denotes a front cowl; reference numeral **32** denotes a front side cowl; reference numeral **33** denotes a rear cowl; reference numeral **34** denotes a front fender; reference numeral **35** denotes a rear fender; and reference numeral **36** denotes a seat.

In addition, the motorcycle **10** includes a pair of left and right intake ducts **26** configured to introduce intake air into the engine via an air cleaner assembly **70** of the intake system **60**. Duct insertion holes **13***a* passing through the main frames **13** in a vehicle-width direction are formed in the left and right main frames **13**, respectively. Through the duct insertion holes **13***a*, the left and right intake ducts **26** extend to the corresponding left and right sides of the air cleaner assembly **70**, respectively.

The depicted engine **50** is a four-cylinder engine arranged in a V configuration. As illustrated in FIG. **1**, the engine **50**

includes a crankcase **51**, a front cylinder block **52**F and a rear cylinder block **52**R arranged in a V-shape on front and rear sides of an upper portion of the crankcase **51**, and an oil pan **53** attached to a lower surface of the crankcase **51**. A left front cylinder and a right front cylinder which are not illustrated are provided inside the front cylinder block **52**F, and a left rear cylinder and a right rear cylinder which are not illustrated are provided inside the rear cylinder block **52**R.

The intake system **60** is connected to a rear surface of the front cylinder block **52**F and a front surface of the rear cylinder block **52**R. An exhaust routing assembly **55** is connected to a front surface of the front cylinder block **52**F and also to a rear surface of the rear cylinder block **52**R.

The exhaust routing assembly **55** includes a front outlet pipe **56**F connected to an exhaust port of the front cylinder block **52**F, a rear outlet pipe **56**R connected to an exhaust port of the rear cylinder block **52**R, and a muffler **57** connected to downstream ends of the front and rear outlet pipes **56**F, **56**R.

As illustrated in FIGS. **2** to **5**, the intake system **60** includes a left front throttle body **61**FL and a right front throttle body **61**FR connected to a left front cylinder and a right front cylinder of the front cylinder block **52**F, respectively, a left rear throttle body **61**RL and a right rear throttle body **61**RR connected to a left rear cylinder and a right rear cylinder of the rear cylinder block **52**R, respectively, and the air cleaner assembly **70** connected to upstream ends of the left front and right front throttle bodies **61**FL, **61**FR and the left rear and right rear throttle bodies **61**RL, **61**RR.

As illustrated in FIG. **4**, the left front throttle body **61**FL includes an intake passage **62** configured to introduce intake air to the left front cylinder of the front cylinder block **52**F, a throttle plate **63** configured to open and close the intake passage **62**, a lower fuel injection valve (fuel injection valve on a downstream side) **64**A configured to inject a fuel into the intake passage **62**, and an air funnel **65** attached to an upstream end of the intake passage **62** and constituting a part of the intake passage **62**. Here, the right front throttle body **61**FR is configured to have a similar structure to the left front throttle body **61**FL.

As illustrated in FIG. **4**, the left rear throttle body **61**RL includes an intake passage **62** configured to introduce intake air to the left rear cylinder of the rear cylinder block **52**R, a throttle plate **63** configured to open and close the intake passage **62**, a lower fuel injection valve (fuel injection valve on the downstream side) **64**A configured to inject the fuel into the intake passage **62**, and an air funnel **65** attached to an upstream end of the intake passage **62** and constituting a part of the intake passage **62**. Here, the right rear throttle body **61**RR is configured to have a similar structure to the left rear throttle body **61**RL.

As illustrated in FIGS. **2** to **5**, the air cleaner assembly **70** includes an air cleaner case **71** having a two-tiered structure including upper and lower layers. This air cleaner case **71** includes an outer case member constituting a lower case **72**, an inner case member constituting a upper case **73** fitted into the lower case **72** from above, and forming a dirty chamber **71***a* between the upper case **73** and the lower case **72**, and a lid portion **74** forming a clean chamber **71***b* between the lid portion **74** and the upper case **73** by occluding an upper opening of the upper case **73**.

With reference to FIG. **4***a*, it will be seen that in the depicted embodiment, the lid portion **74** has a circumferentially extending lower edge with a first grooved channel **74***g* formed therein and facing downwardly. Also, the lower (outer) case **72** has an upper edge with a second grooved channel **72***g* formed therein and facing upwardly. Optionally, the lower (outer) case **72** may have a seal or gasket **72***s* disposed therein and having a C-shaped cross-section. The inner (upper) case **73** has an upper edge with a transverse T-shaped flange **73***f* thereon, the flange including an upper rib **73***u* configured to fit into the first grooved channel **74***g* of the lid, and a lower rib **73***l* configured to fit into the second grooved channel **72***g* of the outer (lower)) case **72**.

It will be seen from the foregoing discussion, in connection with FIGS. **4** and **4***a*, that with the air cleaner case **71** having the described structure, the relative position of the inner (upper) case **73** can be aligned with respect to the outer (lower) case by placing the lower rib **73***l* of the T-shaped flange **73***f* into the second grooved channel **72***g* of the outer (lower)) case **72**, and then the lid portion may be placed over the upper rib, as shown.

A bottom plate (partition plate) **75** of the upper case **73** forms a partition wall that partitions the space inside the air cleaner case **71** into the upper and lower sides defining the clean chamber **71***b* and the dirty chamber **71***a*, respectively. With this structure, the clean chamber **71***b* is formed above the partition plate **75** on the upper side of the air cleaner case **71**, and the dirty chamber **71***a* is formed below the partition plate on the lower side of the air cleaner case.

Moreover, the left and right front throttle bodies **61**FL, **61**FR, the left and right rear throttle bodies **61**RL, **61**RR, and the air funnels **65** are arranged to pass through the dirty chamber **71***a* of the air cleaner case **71** in the up-down direction, and inlets **65***a* of the air funnels **65**, which are inlets of the intake passages **62**, are arranged in the clean chamber **71***b* formed in the upper portion of the air cleaner case **71**, as shown.

Then, as illustrated in FIGS. **2** and **4**, a through hole **75***a*, having an oblong shape extending in the vehicle width direction, is formed in the bottom plate **75** of the upper case **73**. The through hole **75***a* is disposed between the front throttle bodies **61**FL, **61**FR and the rear and throttle bodies **61**RL, **61**RR. An air cleaner element **76**, configured to clean dirt particles and other contaminants from the incoming intake air, is arranged to occlude the through hole **75***a*.

The air cleaner element **76** is formed into an oblong plate-like body having a longitudinal dimension (the dimension in the vehicle width direction) that exceeds a width across the outermost edges of the intake passages **62** of the left front and right front throttle bodies **61**FL, **61**FR. Similarly, the length of the air cleaner element exceeds a width across the outermost edges of the intake passages **62** of the left rear and right rear throttle bodies **61**RL, **61**RR.

In addition, as illustrated in FIGS. **3** and **4**, duct connection portions **72***a* are formed in left and right side walls of the lower case **72**, respectively. Downstream-side ends of the intake ducts **26** are connected to the duct connection portions **72***a*.

Moreover, as illustrated in FIGS. **2** and **4**, upper fuel injection valves (fuel injection valves on the upstream side) **64**B configured to inject the fuel into the respective intake passages **62** are arranged respectively above the left and right front throttle bodies **61**FL, **61**FR and above the left and right rear throttle bodies **61**RL, **61**RR, respectively. Each of the upper fuel injection valves **64**B is supported by a corresponding supporting bracket **66**, provided above and extending across the respective intake passages **62**. Each of the supporting brackets **66** is fixed with two bolts **67** to an upper end portion of the corresponding one of the throttle bodies **61**FL, **61**FR, **61**RL, **61**RR. The upper fuel injection valves **64**B are arranged in the clean chamber **71***b* of the air cleaner case **71**.

As illustrated in FIGS. **2** and **4**, the air cleaner assembly **70** includes a first fuel supply pipe **81**U connected to the upper fuel injection valves **64**B, **64**B of the left and right front throttle bodies **61**FL, **61**FR and extending in the vehicle width direction, a first fuel supply pipe **81**U connected to the upper fuel injection valves **64**B, **64**B of the left and right rear throttle bodies **61**RL, **61**RR and extending in the vehicle width direction, a second fuel connector pipe **82**U connecting the first fuel supply pipes **81**U, **81**U to each other, and a fuel hose **83**U detachably connected to approximately the center of the second fuel connector pipe **82**U. Thus, the upper fuel injection valves **64**B, **64**B on the front side and the upper fuel injection valves **64**B, **64**B on the rear side are connected to each other by the first fuel supply pipes **81**U, **81**U and the second fuel connector pipe **82**U.

In addition, the first fuel supply pipes **81**U, **81**U and the second fuel connector pipe **82**U are arranged above the air cleaner element **76**, and the fuel hose **83**U is detachably connected to the second fuel connector pipe **82**U above the air cleaner element **76**.

Meanwhile, as illustrated in FIGS. **3** and **4**, the air cleaner assembly **70** includes a first fuel supply pipe **81**D connected to the lower fuel injection valves **64**A, **64**A of the left and right front throttle bodies **61**FL, **61**FR and extending in the vehicle width direction, a first fuel supply pipe **81**D connected to the lower fuel injection valves **64**A, **64**A of the left and right rear throttle bodies **61**RL, **61**RR and extending in the vehicle width direction, a second fuel connector pipe **82**D connecting the first fuel supply pipes **81**D, **81**D to each other, and a fuel hose **83**D detachably connected to approximately the center of the second fuel connector pipe **82**D. Thus, the lower fuel injection valves **64**A, **64**A on the front side and the lower fuel injection valves **64**A, **64**A on the rear side are connected to each other by the first fuel supply pipes **81**D, **81**D and the second fuel connector pipe **82**D.

In addition, the first fuel supply pipes **81**D, **81**D and the second fuel connector pipe **82**D are arranged below the air cleaner element **76**, and the fuel hose **83**D is detachably connected to the second fuel connector pipe **82**D below the air cleaner element **76**.

Thus, the air cleaner element **76** is situated at a level between the upper and lower fuel injection valves **64**B, **64**A, and is also arranged between the fuel hose **83**U arranged on the upper side and the fuel hose **83**D arranged on the lower side. Hence, the air cleaner element **76** is arranged below the upper fuel injection valves **64**B and above the lower fuel injection valves **64**A.

Moreover, as illustrated in FIG. **2**, pierced flanges **66***a*, **66***b* are respectively formed at two opposite edge portions of each of the supporting brackets **66** supporting the upper fuel injection valves **64**B. The pierced flanges **66***a*, **66***b* are fixed to each of the throttle bodies **61**FL, **61**FR, **61**RL, **61**RR with the bolts **67**. Each of the supporting brackets **66** is arranged obliquely with respect to a vehicle front-rear direction such that the pierced flange **66***a* on an outer side in the vehicle width direction is located at a position adjacent to the air cleaner element **76**, while the pierced flange **66***b* on an inner side in the vehicle width direction is located at a position spaced away from the air cleaner element **76**.

As illustrated in FIGS. **2** and **6**, a fixture piece (alignment portion) **66***c* is formed integrally at the pierced flange **66***a* of the supporting bracket **66** on the outer side in the vehicle width direction. The fixture piece **66***c* fixes an installed position of the air cleaner element **76** by pressing down on an edge portion of the air cleaner element **76** from above. For this purpose, the fixture pieces **66***c* are respectively arranged near distant-and-opposite outer edges of the intake passages **62** of the left front and right front throttle bodies **61**FL, **61**FR neighboring in the left-right direction, and near distant-and-opposite outer edges of the intake passages **62** of the left rear and right rear throttle bodies **61**RL, **61**RR neighboring in the left-right direction.

In the air cleaner assembly **70** configured as described above, when the eight bolts **67** are unscrewed and thereby the four supporting brackets **66** are detached, the fixation of the air cleaner element **76** is released and the air cleaner element **76** can be removed for cleaning or replacement.

Moreover, as illustrated in FIGS. **3** and **5**, a cylindrical gas outlet portion **51***a*, configured to discharge a blowby gas, is provided to protrude between the front and rear cylinder blocks **52**F, **52**R on the upper surface of the crankcase **51** of the engine **50**. The gas outlet portion **51***a* is arranged to extend through a bottom plate **72***b* of the lower case **72** of the air cleaner case **71** to the inside of the dirty chamber **71***a*. Then, a gas outlet hose **77** is connected to the gas outlet portion **51***a*. A downstream end of this gas outlet hose **77** is connected to a joint **75***b* formed in the bottom plate **75** of the upper case **73** of the air cleaner case **71** and communicating with the clean chamber **71***b*. As a result, the blowby gas from the crankcase **51** is discharged into the clean chamber **71***b* via the gas outlet hose **77**.

As described above, according to the vehicular intake system **60** of the present embodiment, the through hole **75***a* is formed between the left and right front throttle bodies **61**FL, **61**FR and the left and right rear throttle bodies **61**RL, **61**RR in the bottom plate **75** of the upper case **73** of the air cleaner case **71**, and the air cleaner element **76** is arranged to occlude the through hole **75***a*. Thus, the air cleaner element **76** can be arranged by using a space between the front throttle bodies **61**FL, **61**FR and the rear throttle bodies **61**RL, **61**RR. This makes it possible to maintain a small size of the air cleaner assembly **70**.

Moreover, according to the vehicular intake system **60** of the present embodiment, the air cleaner element **76** is formed into the plate-like body having the longitudinal dimension that exceeds the width across the outermost edges of the intake passages **62** of the left front and right front throttle bodies **61**FL, **61**FR and the left rear and right rear throttle bodies **61**RL, **61**RR. Accordingly, even when the air cleaner element **76** is arranged in the space between the left front and right front throttle bodies **61**FL, **61**FR and the left rear and right rear throttle bodies **61**RL, **61**RR, which are narrowly spaced, the cleaning area of the air cleaner element **76** can be secured.

Further, according to the vehicular intake system **60** of the present embodiment, the air cleaner element **76** is arranged below the upper fuel injection valves **64**B. Thus, even when the upper fuel injection valves **64**B are arranged in the clean chamber **71***b*, the air cleaner element **76** can be arranged in an empty space where the air cleaner element **76** does not interfere with the upper fuel injection valves **64**B.

Additionally, according to the vehicular intake system **60** of the present embodiment, the first and second fuel supply pipes **81**U, **82**U connecting the front and rear upper fuel injection valves **64**B to each other are arranged above the air cleaner element **76**, and the fuel hose **83**U is detachably connected to the second fuel connector pipe **82**U above the air cleaner element **76**. Thus, in the cleaning or replacement of the air cleaner element **76**, the fuel hose **83**U can be easily detached and thereby the air cleaner element **76** can be easily detached.

In addition, according to the vehicular intake system **60** of the present embodiment, the air cleaner element **76** is arranged between the upper fuel injection valves **64**B on the

upstream side, and the lower fuel injection valves **64**A on the downstream side. Thus, the air cleaner element **76** can be arranged in an empty space where the air cleaner element **76** does not interfere with the first and upper fuel injection valves **64**A, **64**B.

Still further, according to the vehicular intake system **60** of the present embodiment, the air cleaner element **76** is arranged between the fuel hose **83**U connected to the upper fuel injection valves **64**B on the upstream side, and the fuel hose **83**D connected to the lower fuel injection valves **64**A on the downstream side. Thus, in the cleaning or replacement of the air cleaner element **76**, the fuel hose **83**U on the upstream side can be easily detached and attached. In addition, since the fuel hose **83**D on the downstream side can be viewed through the through hole **75***a* of the bottom plate **75** of the upper case **73**, the fuel hose **83**D on the downstream side can be easily detached and attached.

Yet further, according to the vehicular intake system **60** of the present embodiment, the fixture pieces **66***c* to align a position of the air cleaner element **76** are formed integrally in the supporting brackets **66** to support the upper fuel injection valves **64**B. Thus, there is no need to provide any additional members to align a position of the air cleaner element **76**. This enables reduction in the number of parts, and consequently leads to reduction in manufacturing costs.

Still furthermore, according to the vehicular intake system **60** of the present embodiment, the fixture pieces **66***c* of the supporting brackets **66** are arranged respectively near distant-and-opposite outer edges of the intake passages **62** of the left front and right front throttle bodies **61**FL, **61**FR neighboring in the left-right direction, and near distant-and-opposite outer edges of the intake passages **62** of the left rear and right rear throttle bodies **61**RL, **61**RR neighboring in the left-right direction. Thus, the positions of the fixture pieces **66***c* fixing the air cleaner element **76** are spaced, so that the air cleaner element **76** can be firmly fixed.

It should be noted that the present invention must not be limited to that illustrated in the foregoing embodiment, but may be modified as needed without deviating from the scope of the present invention.

For example, in the present embodiment, the fixture pieces **66***c* to align a position of the air cleaner element **76** are provided integrally in the supporting brackets **66** to support the upper fuel injection valves **64**B. However, the present invention is not limited to this. The fixture pieces **66***c* may be provided as pieces separate from the supporting brackets **66**.

In addition, the present embodiment illustrates the case where the present invention is applied to a four-cylinder V-type engine. However, the present invention is not limited to this. The present invention may be applied to a V-twin engine.

In other words, although the present invention has been described herein with respect to a specific illustrative embodiment, the foregoing description is intended to illustrate, rather than to limit the invention. Those skilled in the art will realize that many modifications of the illustrative embodiment could be made which would be operable. All such modifications, which are within the scope of the appended claims, are intended to be within the scope and spirit of the present invention.

What is claimed is:

1. A vehicular intake system comprising:

a multicylinder engine including at least one front cylinder block and at least one rear cylinder block;

a plurality of intake passages configured to introduce intake air to the front and rear cylinder blocks, respectively, the engine comprising a plurality of air funnels defining portions of the intake passages, including at least one front air funnel for introducing air to the front cylinder block and at least one rear air funnel for introducing air to the rear cylinder block; and

an air cleaner assembly connected to upstream ends of the intake passages for the front and rear cylinder blocks, the air cleaner assembly comprising an air cleaner case and an air cleaner element disposed inside of the case;

wherein:

a space inside of the air cleaner case is partitioned into upper and lower parts by a partition wall, thereby forming a clean chamber on the upper side and a dirty chamber on the lower side,

the intake passages are arranged to pass through the dirty chamber in a vertical direction, and inlets of the intake passages are arranged in the clean chamber,

a through hole is formed in the partition wall between the front and rear air funnels for the front and rear cylinder blocks, respectively, and

an air cleaner element configured to clean the intake air is arranged to occlude the through hole, the air cleaner element arranged substantially horizontally between the front and rear air funnels.

2. The vehicular intake system according to claim **1**, wherein the engine is a V engine, and the air cleaner element comprises a plate-like body having a longitudinal dimension that exceeds a width across outermost edges of the intake passages for each of the front and rear cylinder blocks.

3. The vehicular intake system according to claim **1**, wherein front and rear fuel injection valves configured to inject a fuel to the respective intake passages for the front and rear cylinder blocks are arranged in the clean chamber, and the air cleaner element is arranged below the fuel injection valves.

4. The vehicular intake system according to claim **3**, wherein a fuel supply pipe connecting the front and rear fuel injection valves to each other is arranged above the air cleaner element, and a fuel hose is detachably connected to the fuel supply pipe above the air cleaner element.

5. The vehicular intake system according to claim **3**, wherein:

the fuel injection valves are upper fuel injection valves situated on an upstream side of the intake passages,

the intake system comprises throttle bodies each having a respective intake passage formed therein for one of the front and rear cylinder blocks, and each having a lower fuel injection valve attached thereto on a downstream side, and

the air cleaner element is arranged at a level between the upper fuel injection valves and the lower fuel injection valves.

6. The vehicular intake system according to claim **5**, wherein the air cleaner element is arranged between a fuel hose connected to the fuel injection valves on the upstream side, and a fuel hose connected to the fuel injection valves on the downstream side.

7. The vehicular intake system according to claim **3**, further comprising a plurality of supporting members configured to support the front and rear fuel injection valves above the intake passages, respectively,

wherein each of the supporting members is provided with an air cleaner alignment portion configured to align an installed position of the air cleaner element.

8. The vehicular intake system according to claim **7**, wherein

the engine is arranged in a V-shaped configuration comprising two front cylinder blocks and two rear cylinder blocks, and

the alignment portions of the supporting members are arranged respectively near distant-and-opposite outer edges of the neighboring intake passages for the two front cylinder blocks, and near distant-and-opposite outer edges of the neighboring intake passages for the two rear cylinder blocks.

9. The vehicular intake system according to claim **1**, wherein:

the air cleaner case comprises:

an outer case member which substantially surrounds and encloses the air funnels,

an inner case member which fits inside of the outer case member, the inner case member comprising a floor portion which defines said partition wall, and

a lid portion which covers the inner and outer case members.

10. The vehicular intake system according to claim **9**, wherein:

the lid portion has a lower edge with a first grooved channel formed therein and facing downwardly;

the outer case has an upper edge with a second grooved channel formed therein and facing upwardly; and

the inner case has an upper edge with a transverse T-shaped flange thereon, the flange comprising an upper rib configured to fit into the first grooved channel of the lid, and a lower rib configured to fit into the second grooved channel of the outer case,

whereby the relative position of the inner case can be aligned with respect to the outer case by placing the lower rib of the transverse T-shaped flange into the second grooved channel.

11. A vehicular intake system comprising:

a multicylinder engine formed in a V configuration and including at least one front cylinder block and at least one rear cylinder block;

a plurality of intake passages configured to introduce intake air to the front and rear cylinder blocks, respectively, the engine comprising a plurality of air funnels defining portions of the intake passages including at least one front air funnel for introducing air to the front cylinder block and at least one rear air funnel for introducing air to the rear cylinder block; and

an air cleaner assembly disposed in a space formed between the front and rear cylinder blocks and fluidly connected to upstream ends of the intake passages for the front and rear cylinder blocks, the air cleaner assembly comprising an air cleaner case and an air cleaner element disposed inside of the case, the air cleaner case comprising:

an outer case member which substantially surrounds and encloses the air funnels;

an inner case member which fits inside of the outer case member, the inner case member comprising a floor portion which defines a partition wall; and

a lid portion which covers the inner and outer case members;

wherein:

a space inside of the air cleaner case is partitioned into upper and lower parts by said partition wall, thereby forming a clean chamber on the upper side of the partition wall and a dirty chamber on the lower side,

the intake passages are arranged to pass through the dirty chamber in a vertical direction, and inlets of the intake passages are arranged in the clean chamber,

a through hole is formed between the intake passages for the front and rear cylinder blocks in the partition wall, and

the air cleaner element is arranged to occlude the through hole, the air cleaner element arranged substantially horizontally between the air funnels for the front and rear cylinder blocks, respectively.

12. The vehicular intake system according to claim **11**, wherein the air cleaner element comprises a plate-like body having a longitudinal dimension that exceeds a width across outermost edges of the intake passages for each of the front and rear cylinder blocks.

13. The vehicular intake system according to claim **11**, wherein front and rear fuel injection valves configured to inject a fuel to the respective intake passages for the front and rear cylinder blocks are arranged in the clean chamber, and the air cleaner element is arranged below the fuel injection valves.

14. The vehicular intake system according to claim **13**, wherein a fuel supply pipe connecting the front and rear fuel injection valves to each other is arranged above the air cleaner element, and a fuel hose is detachably connected to the fuel supply pipe above the air cleaner element.

15. The vehicular intake system according to claim **13**, wherein:

the fuel injection valves are upper fuel injection valves situated on an upstream side of the intake passages,

the intake system comprises throttle bodies each having a respective intake passage formed therein for one of the front and rear cylinder blocks, and each having a lower fuel injection valve attached thereto on a downstream side, and

the air cleaner element is arranged at a level between the upper fuel injection valves and the lower fuel injection valves.

16. The vehicular intake system according to claim **15**, wherein

the air cleaner element is arranged between a fuel hose connected to the fuel injection valves on the upstream side, and a fuel hose connected to the fuel injection valves on the downstream side.

17. The vehicular intake system according to claim **13**, further comprising a plurality of supporting members configured to support the front and rear fuel injection valves above the intake passages, respectively,

wherein each of the supporting members is provided with an air cleaner alignment portion configured to align an installed position of the air cleaner element.

18. The vehicular intake system according to claim **17**, wherein

the engine comprises two front cylinder blocks and two rear cylinder blocks, and

the alignment portions of the supporting members are arranged respectively near distant-and-opposite outer edges of the neighboring intake passages for the two front cylinder blocks, and near distant-and-opposite outer edges of the neighboring intake passages for the two rear cylinder blocks.

19. The vehicular intake system according to claim **11**, wherein:

the lid portion has a lower edge with a first grooved channel formed therein and facing downwardly;

the outer case has an upper edge with a second grooved channel formed therein and facing upwardly; and

the inner case has an upper edge with a transverse T-shaped flange thereon, the flange comprising an upper rib configured to fit into the first grooved channel

of the lid, and a lower rib configured to fit into the second grooved channel of the outer case,

whereby the relative position of the inner case can be aligned with respect to the outer case by placing the lower rib of the transverse T-shaped flange into the second grooved channel.

20. A vehicular intake system comprising:

a multicylinder engine including at least one front cylinder block and at least one rear cylinder block, the engine comprising a plurality of air funnels defining portions of the intake passages, including at least one front air funnel for introducing air to the front cylinder block and at least one rear air funnel for introducing air to the rear cylinder block;

a plurality of intake passages configured to introduce intake air to the front and rear cylinder blocks, respectively; and

an air cleaner assembly connected to upstream ends of the intake passages for the front and rear cylinder blocks, the air cleaner assembly comprising an air cleaner case and an air cleaner element disposed inside of the case;

wherein:

a space inside of the air cleaner case is partitioned into upper and lower parts by a partition wall, thereby forming a clean chamber on the upper side and a dirty chamber on the lower side,

the air cleaner case is configured to admit intake air into the dirty chamber and route it upwardly through the air cleaner element to the clean chamber,

the intake passages are arranged to pass through the dirty chamber in a vertical direction, and inlets of the intake passages are arranged in the clean chamber,

a through hole is formed between the intake passages for the front and rear cylinder blocks in the partition wall,

an air cleaner element configured to clean the intake air is arranged to occlude the through hole,

front and rear upper fuel injection valves, configured to inject a fuel to the respective intake passages for the front and rear cylinder blocks, are arranged inside of the air cleaner assembly in the clean chamber,

the engine further comprises a plurality of supporting bracket members disposed inside of the air cleaner case, operatively attached to the air funnels and configured to support the front and rear fuel injection valves above the intake passages, respectively, each of the supporting bracket members provided with an air cleaner alignment portion configured to contact and align the air cleaner element in an installed position thereof,

and the air cleaner element is arranged at a level below the upper fuel injection valves.

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